

Applicant : James R. Fitzell, Jr.
Serial No. : 10/807,760
Page No. : 6

REMARKS

Applicant respectfully requests reconsideration of the above identified patent application. Claims 1-4 and 33-48 are pending in the application. Claims 1 and 3 are amended and claims 33-48 are added to more particularly point out and distinctly claim the subject matter that Applicant regards as the invention. Applicant respectfully traverses the claim rejections as conceivably applied to the amended claims.

I. Invention Summary

The present invention is directed to a method for thermoforming that includes molding a thermoplastic sheet on a vacuum mold and quenching the thermoformed sheet in a quench while the thermoplastic sheet remains on the vacuum mold.

With respect to amended independent claim 1, the present invention is directed to a method for thermoforming, including: providing a vacuum mold having an internal vacuum chamber; heating a thermoplastic material; forming the heated thermoplastic material on the vacuum mold, including drawing a partial vacuum in the internal vacuum chamber; and cooling the formed thermoplastic material by quenching the thermoplastic material in a quench reservoir while the thermoplastic material remains on the vacuum mold.

With respect to new independent claim 33, the present invention is directed to a method for forming a sheet of thermoplastic material, including: providing a vacuum mold having a surface and an internal vacuum chamber, the mold defining a plurality of vacuum holes extending between the surface and the vacuum chamber; providing a quench containing a quench media including at least one of a liquid and ceramic beads; heating the thermoplastic material;

Applicant : James R. Fitzell, Jr.
Serial No. : 10/807,760
Page No. : 7

vacuum forming the heated thermoplastic material on the surface by applying a partial vacuum to the thermoplastic material through the vacuum holes; and moving one of the quench and the mold to quench the thermoplastic material in the quench media while the thermoplastic material is retained on the surface of the mold.

With respect to new independent claim 42, the present invention is directed to a thermoforming method including: providing a cooling tank containing a quench media including at least one of a liquid and ceramic beads; providing a mold including at least one of a vacuum cabinet and a vacuum line network in fluid communication with the environment through a plurality of vacuum holes defined by the mold; and actuating an actuator system between a draw position wherein the mold draws a thermoformable sheet against the mold with a partial vacuum, and a quench position wherein the mold is quenched in the quench media, the cooling tank disengaged from the vacuum mold and the thermoplastic sheet when the actuator system is in the drawing position.

II. Section 102 Rejections

A. Rejection based on Japanese Patent to Otahiko

As originally filed, claims 1-3 were rejected under 35 U.S.C. 102(b) as being anticipated by Japanese Patent 04-033827 to Otahiko.

Otahiko discloses a method and apparatus for forming thermoplastic sheets that utilizes a pressurized gas to hold the sheet on the mold. The method required actuating a vacuum for holding a first side of the sheet on the mold, but also requires forcing the second side of the sheet against the mold with a pressurized gas. The gas is a refrigerant that is provided by a

Applicant : James R. Fitzell, Jr.
Serial No. : 10/807,760
Page No. : 8

pressure box. The pressure box is engaged during the molding process to assist in forcing the sheet against the mold. The sheet is quenched by the refrigerant at the same time the refrigerant assists in forcing the sheet against the mold.

With respect to amended independent claim 1, Otahiko does not disclose quenching the thermoplastic material in a quench reservoir containing a quench media.

With respect to new independent claim 33, Otahiko does not disclose 1) a quench containing a quench media including of at least one of a liquid and ceramic beads or 2) moving one of the quench and the mold to quench the thermoplastic material in the quench media while the thermoplastic material is retained on the surface of the mold.

With respect to new independent claim 42, Otahiko does not disclose 1) a cooling tank containing a quench media including at least one of a liquid and ceramic beads or 2) actuating an actuator system between a draw position wherein the mold draws a thermoformable sheet against the mold with a partial vacuum, and a quench position wherein the mold is quenched in the quench media, the cooling tank disengaged from the vacuum mold and the thermoplastic sheet when the actuator system is in the drawing position

In contrast to the present invention, Otahiko discloses a molding system that uses a gas pressure box. These types of molding systems are common, and they require using the gas pressure box during the molding process to hold the sheet on the mold. Pressure box systems are relatively expensive and complex, requiring coordination between the operation of a vacuum and a separate pressure box. The present invention is much simpler, because the sheet is formed on

Applicant : James R. Fitzell, Jr.
Serial No. : 10/807,760
Page No. : 9

the vacuum mold – without the need for a pressure box – and then quenched in a quench media while it is retained on the vacuum mold.

B. Rejection based on U.S. Patent to Saeki

As originally filed, claims 1 and 3 were rejected under 35 U.S.C. 102(b) as being anticipated by Japanese Patent No. 360033799 to Saeki.

Saeki discloses a method for quenching a thermoformed polyethylene film on a die. A polyethylene film diaphragm that has been “obtained by the vacuum forming method or the pressure forming method is placed on a metal die,” (i.e. separate from the mold). The die has a vacuum hole for holding the diaphragm in place on the die. Heated air is then blown onto the diaphragm to bring the diaphragm near its melting temperature, and then cooled water is blown onto the diaphragm to quench the diaphragm.

With respect to amended independent claim 1, Saeki does not disclose 1) forming a thermoplastic material on a vacuum mold and quenching the thermoplastic material while it remains on the vacuum mold or 2) quenching the thermoplastic material in a quench reservoir.

With respect to new independent claim 33, Saeki does not disclose 1) providing a quench containing a quench media including of at least one of a liquid and ceramic beads; or 2) moving one of the quench and the mold to quench the thermoplastic material in the quench media while the thermoplastic material is retained on the surface of the mold.

With respect to new independent claim 42, Saeki does not disclose 1) providing a cooling tank; 2) providing a quench media including at least one of a liquid and ceramic beads; or 3) actuating an actuator system between a draw position wherein the mold draws a

Applicant : James R. Fitzell, Jr.
Serial No. : 10/807,760
Page No. : 10

thermoformable sheet against the mold with a partial vacuum, and a quench position wherein the mold is quenched in the quench media, the cooling tank disengaged from the vacuum mold and the thermoplastic sheet when the actuator system is in the drawing position.

Applicant submits that there are significant differences between Saeki and the method disclosed by the present invention. Saeki teaches away from the present invention by placing an already formed thermoplastic diaphragm on a metal die, heating the diaphragm on the die, and then cooling the thermoplastic while it is on the die by blowing water on it. The method of the present invention is streamlined in that there is no need to remove the formed thermoplastic from the mold, move it to a separate die, and then re-heat the thermoplastic on the die. In addition, the present invention does not require an additional mechanism for spraying cooled water on the thermoplastic, as is required by Saeki.

Because neither Otahiko nor Saeki disclose every element of amended independent claim 1 or new independent claims 33 or 42, Applicant submits that the rejections with respect to Section 102 are unfounded and/or overcome.

III. Section 103 Rejections

A. Rejection based on Saeki

Claim 4 was rejected under 35 U.S.C. 103 as being unpatentable over Saeki.

It is asserted that it is well known in the vacuum forming art to remove or eject an article by blowing a gas against the article, and that therefore the subject matter of claim 4 would have been obvious in light of Saeki. Applicant submits that the knowledge of skill in the art does not resolve the above noted inadequacies of Saeki with respect to amended claim 1, from which

Applicant : James R. Fitzell, Jr.
Serial No. : 10/807,760
Page No. : 11

claim 4 depends. For instance, Saeki does not disclose 1) forming a thermoplastic material on a vacuum mold and quenching the thermoplastic material while it remains on the vacuum mold or 2) quenching the thermoplastic material in a quench reservoir.

B. Rejection based on Otahiko in view of Saeki

Claim 2 was rejected under 35 U.S.C. 103 as being unpatentable over Otahiko in view of Saeki.

It is asserted that Otahiko teaches all of the elements of claim 2, except quenching a thermoplastic material at a constant temperature, and that Saeki teaches quenching a thermoplastic material at a constant temperature.

Applicant submits that the combination of Saeki and Otahiko does not resolve the above noted inadequacies of Saeki and Otahiko individually, as discussed above with respect to amended independent claim 1, from which claim 2 depends. In particular, neither Saeki nor Otahiko disclose, teach or suggest cooling the formed thermoplastic material by quenching the thermoplastic material in a quench reservoir while the thermoplastic material remains on the vacuum mold. In addition, with respect to new independent claim 33, neither Saeki nor Otahiko disclose, teach, or suggest moving one of the quench and the mold to quench the thermoplastic material in the quench media while the thermoplastic material is retained on the surface of the mold. With respect to new independent claim 42, neither Saeki nor Otahiko teach 1) cooling the sheet in a cooling tank or 2) actuating an actuator system between a draw position wherein the mold draws a thermoformable sheet against the mold with a partial vacuum, and a quench

Applicant : James R. Fitzell, Jr.
Serial No. : 10/807,760
Page No. : 12

position wherein the mold is quenched in the quench media, the cooling tank disengaged from the vacuum mold and the thermoplastic sheet when the actuator system is in the drawing position

Additionally, there is no basis in the art to suggest modifying or combining Otahiko and Saeki. Otahiko discloses a quench that only works with specific molding systems that utilize a pressure box to assist in drawing the sheet over the mold. Saeki is not one of those systems that requires a pressure box, and therefore would have no need for a quench that requires a pressure box.

C. Rejection based on Otahiko

Claim 4 was rejected under 35 U.S.C. 103 as being unpatentable over Otahiko.

As discussed above, it is asserted that it is well known in the art to remove or eject an article by reversing the vacuum and blowing a gas against the article. It is asserted that in view of Otahiko and this knowledge, the subject matter of claim 4 is obvious. Applicant disagrees with this assertion, and further submits that this knowledge does not resolve the noted inadequacies of Otahiko as discussed above with respect to independent claim 1, from which claim 4 depends. In particular, Otahiko teaches the use of a pressure box, and does not teach quenching the thermoplastic material in a quench reservoir containing a quench media.

Because none of the cited references teach or suggest the subject matter of the amended claims, Applicant submits that the rejections under Section 103 are overcome and/or should be withdrawn.

Applicant : James R. Fitzell, Jr.
Serial No. : 10/807,760
Page No. : 13

IV. Dependent Claims

The dependent claims not previously discussed depend from amended independent claims 1 or new independent claims 33 and 42, and are therefore even more clearly allowable. Claim 3 recites quenching the thermoplastic material in a quench media selected from the group consisting of water, oil, coolant and ceramic beads. Claim 34 recites moving the quench towards the mold so that at least a portion of the mold is positioned within the quench while the thermoplastic material is retained on the mold, whereby at least a portion of the thermoplastic material is in direct contact with the quench media. Claim 35 recites providing a quench reservoir, the quench reservoir being of sufficient size to receive the mold while a thermoplastic material is retained on the mold. Claim 36 recites maintaining the quench media at a substantially constant temperature. Claim 37 recites moving one of the quench and the mold by actuating a plurality of hydraulic cylinders. Claims 38 and 43 recite holding at least one sheet of the thermoplastic material in a supported position on a rack. Claim 39 recites supporting the mold on a carriage that is translatable between a first position wherein the mold contacts and draws the sheet and a second position wherein the carriage disposes the mold with the sheet retained thereon in the quench. Claim 40 recites rotating the carriage along an axis so that in the first position the mold faces the sheet and so that in the second position the mold faces the quench. Claim 41 recites translating the mold between the first and second positions by rotating the carriage about 180 degrees. Claim 44 recites driving the mold through the rack to contact the sheet and move the sheet with the mold into the cooling tank and into the quench position. Claim 45 recites moving the mold into the draw position and then rotating the mold a pre-

Applicant : James R. Fitzell, Jr.
Serial No. : 10/807,760
Page No. : 14

selected angle so that the mold is moveable into the quench position. Claim 46 recites operating a plurality of pneumatic cylinders that move the mold in a first direction to the draw position and then retract the mold away from the draw position in a second direction until the mold is disposed in the quenched position. Claim 47 recites holding the thermoformable sheet in a rack and driving the mold into contact with the thermoformable sheet in a first direction and then retracting the mold after the thermoformable sheet is drawn against the mold in a second direction opposite the first direction until the mold attains the quenched position. Claim 48 recites moving the cooling tank toward the mold to quench the mold in the quench media.

V. Conclusion

In view of the claim amendments and these remarks, Applicant submits that the present invention is in condition for allowance. A notice to that effect is respectfully and earnestly requested. The Examiner is invited to contact the undersigned by telephone should the Examiner feel that additional changes are necessary to place the application in allowable form.

Respectfully submitted,

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